GEO-CAPE Oceans STM

Draft v.4.6 - Feb. 28, 2013

Science Focus	Science Questions	Approach (Maps to Science Question)	Measurement Requirements	Instrument Requirements	Platform Requirem.	Ancillary Data Requirem
Short-Term Processes **Land-Ocean Exchange** **Impacts of Climate Change & Human Activity** **Impacts of Airborne-Derived Fluxes** **Episodic Events & Hazards**	**1** **How do short-term coastal and open ocean processes interact with and influence larger scale physical, biogeochemical and ecosystem dynamics?** (OBB 1) **2** **How are variations in exchanges across the land-ocean interface related to changes within the watershed, and how do such exchanges influence coastal and open ocean biogeochemistry and ecosystem dynamics?** (OBB 1 & 2; CCSP 1 & 3) **3** **How are the productivity and biodiversity of coastal ecosystems changing, and how do these changes relate to natural and anthropogenic forcing, including local to regional impacts of climate variability?** (OBB 1, 2 & 3; CCSP 1 & 3) **4** **How do airborne-derived fluxes from precipitation, fog and episodic events such as fires, dust storms & volcanoes affect the ecology and biogeochemistry of coastal and open ocean ecosystems?** (OBB 1 & 2; CCSP 1) **5** **How do episodic hazards, contaminant loadings, and alterations of habitats impact the biology and ecology of the coastal zone?** (OBB 4)	GEO-CAPE will observe coastal regions at sufficient temporal and spatial scales to resolve near-shore processes, tides, coastal fronts, and eddies, and track carbon pools and pollutants. Two complementary operational modes will be employed: (1) survey mode for evaluation of diurnal to interannual variability of constituents, rate measurements and hazards for estuarine and continental shelf and slope regions with linkages to open-ocean processes at appropriate spatial scales, and (2) targeted, high-frequency sampling for observing episodic events including evaluating the effects of diurnal variability on upper ocean constituents, assessing the rates of biological processes and coastal hazards. *Measurement objectives for both modes include:* (a) Quantify dissolved and particulate carbon pools and related rate measurements such as export production, air-sea CO2 exchange, net community production, respiration, and photochemical oxidation of dissolved organic matter. (b) Quantify phytoplankton properties: biomass, pigments, functional groups (size/taxonomy/Harmful Algal Blooms (HABs)), daily primary productivity using bio-optical models, vertical migration, and chlorophyll fluorescence. (c) Measure the inherent optical properties of coastal ecosystems: absorption and scattering of particles, phytoplankton and detritus, CDOM absorption. (d) Estimate upper ocean particle characteristics including particle abundance and particle size distribution. (e) Detect, quantify and track hazards including HABs and petroleum-derived hydrocarbons. GEO-CAPE observations will be integrated with field measurements, models and other satellite data: (1) to derive coastal carbon budgets and determine whether coastal ecosystems are sources or sinks of carbon to the atmosphere, (2) to quantify the responses of coastal ecosystems and biogeochemical cycles to river discharge, land use change, airborne-derived fluxes, hazards and climate change, and (3) to enhance management decisions with improved information on the coastal ocean, such as required for Integrated Ecosystem Assessment (IEA), protection of water quality, and mitigation of harmful algal blooms, oxygen minimum zones, and ocean acidification.	Water-leaving radiances in the near-UV, visible & NIR for separating absorbing & scattering constituents & chlorophyll fluorescence Product uncertainty TBD **Temporal Resolution:** *Targeted Events:* • Threshold: ≤1 hour • Baseline: ≤0.5 hour *Survey Coastal U.S.:* • Threshold: ≤3 hours • Baseline: ≤1 hour *Regions of Special Interest (RSI): Threshold: ≥1 RSI 3 scans/day* • Baseline: multiple RSI 3 scans/day *Other coastal and large inland bodies of water within ocean color FOR:* • Baseline: ≤3 hours **Spatial Resol. (nadir):** • Threshold: ≤375 x 375 m • Baseline: ≤250 x 250 m **Field of Regard for Ocean Color Retrievals:** 60°N to 60°S; 155°W to 35°W **Coastal Coverage*:** width from coast to ocean: • Threshold: min 375 km • Baseline: min 500 km **Scanning Priority:** •Threshold: 1. U.S. Coastal Waters* 3 to 8 times per day 2. Other coastal and large inland bodies of water 3. Open ocean waters within FOR	**Spectral Range:** Hyperspectral UV-VIS-NIR • Threshold: 345-1050 nm; 2 SWIR bands 1245 & 1640 nm • Baseline: 340-1100 nm; 3 SWIR bands 1245, 1640, 2135 nm **•Spectral Sampling & Resolution:** • Threshold: UV-Vis-NIR: ≤2 & ≤5nm; 400-450nm: ≤0.4 & ≤0.8nm (for NO_2 at spatial resolution of 750x750m at nadir); SWIR resolution: ≤20-40 nm • Baseline: UV-ViS-NIR: ≤0.25 & 0.75 nm; SWIR: ≤20-50 nm **Signal-to-Noise Ratio (SNR) at Ltyp(70˚ SZA):** • Threshold: ≥1000 for 10 nm FWHM (350-800 nm); ≥600 for 40 nm FWHM (800-900 nm); ≥300 for 40 nm FWHM (900-1050 nm); ≥250 and ≥180 for 1245 & 1640 nm (20 & 40 nm FWHM); ≥500 NO_2 band. • Baseline: ≥1500 for 10 nm (350-800 nm); NIR, SWIR and NO_2 bands same as threshold; ≥100 for the 2135nm (50nm FWHM) • Threshold: Aggregate SWIR bands to 2x2 GSD pixels to meet SNR; Baseline: No aggregation. **Scanning area per unit time:** Threshold: ≥25,000 km^2/min; Baseline: ≥50,000 km^2/min **Field of Regard:** • Full disk: 20.8° E-W and 19° N-S imaging capability from nadir for Lunar & Solar Calibrations **Non-saturating detector array(s) at Lmax** **On-board Calibration:** • Lunar: Threshold: minimum monthly; Baseline: same as threshold • Solar: Threshold: none; Baseline: daily **Polarization Sensitivity:** <1.0% **Relative Radiometric Precision:** • Threshold: ≤1% through mission lifetime • Baseline: ≤0.5% through mission lifetime **Mission lifetime:** Threshold: 3 years; Goal: 5 years **Intelligent Payload Module** Baseline only: Near Real-Time satellite data download from other sensors (GOES, etc.) for on-board autonomous decision making. **Pre-launch characterization:** Adequate to achieve the required on-orbit radiometric precision	Geostationary orbit at 95W longitude to permit sub-hourly observations of coastal waters adjacent to the continental U.S., North, Central and South America Storage (up to 1 day) and download of full spatial data and spectral data.	Western hemisphere data sets from models, missions, or field observations **Measurement Requirements** (1) Ozone (2) Total water vapor (3) Surface wind velocity (4) Surface barometric pressure (5) Vicarious calibration & validation - coastal (6) Full prelaunch characterization (7) Cloud cover **Science Requirements** (1) SST (2) SSH (3) PAR (4) UV solar irradiance (5) MLD (6) Air/Sea pCO2 (7) pH (8) Ocean circulation (9) Tidal & other coastal currents (10) Aerosol deposition (11) run-off loading in coastal zone (12) Wet deposition in coastal zone (13) Wave height & surface wind speed **Validation Requirements** Conduct high frequency field measurements and modeling to validate GEO-CAPE retrievals from river mouths to beyond the edge of the continental margin.

Error (as % of nadir pixel)	**Threshol**	**Baselin**
Pointing Knowledge LOS	**<50%**	**<10%**
Pointing Accuracy LOS	**<100%**	**<25%**
Pointing Stability LOS	**<50%**	**<10%**
Geolocation Reconstr.	**<100%**	**<10%**

GEO-CAPE Science Questions are traceable to NASA's OBB Advanced Planning Document (OBB) and the U.S. Carbon Cycle Science Plan (CCSP).

* Coastal coverage within field-of-view (FOV) includes major estuaries and rivers such as Chesapeake Bay, Lake Pontchartrain/Mississippi River delta and the Laurentian Great Lakes, e.g., the Chesapeake Bay coverage region would span west to east from Washington D.C. to several hundred kilometers offshore (total width of 375 km threshold).